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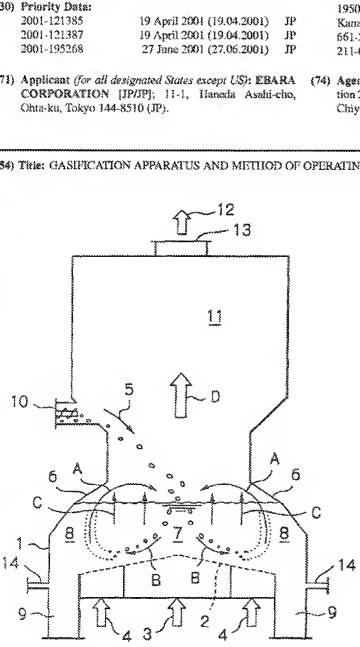
(54) Title: GASIFICATION APPARATUS AND METHOD OF OPERATING THE SAME



(57) Abstract: A gasification apparatus in which a fluidizing gas is supplied into a furnace from the furnace bottom to form a descending fluidized bed 7 and an ascending fluidized bed 8 in the furnace. The gasification apparatus has an incombustible matter discharge passage 9 below the ascending fluidized bed 8. Combustible matter 5 is cast into the upper part of the descending fluidized bed 7 to burn and gasify the combustible matter 5. A fluidized medium stirring means is provided in the incombustible matter discharge passage 9 or an inert gas is supplied through a supply opening 14 into or near the passage 9 to prevent the formation of clinker in the passage 9 or in or near the entrance thereof, which would otherwise clog the incombustible matter discharge opening.

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DESCRIPTION

GASIFICATION APPARATUS AND METHOD OF OPERATING THE SAME

TECHNICAL FIELD

The present invention relates to a gasification apparatus in which combustible matter, e.g. waste matter or coal, is gasified and subjected to melt combustion in a fluidized-bed furnace, and also pertains to a method of operating the gasification apparatus. More particularly, the present invention relates to a gasification apparatus designed to prevent the formation of clinker at an incombustible matter discharge opening of a fluidized bed so that the incombustible matter discharge opening will not be clogged with clinker (or clogging of the incombustible matter discharge opening is prevented). The present invention also relates to a method of operating the gasification apparatus.

In addition, the present invention relates to a gasification and melt combustion apparatus for gasifying combustible matter, e.g. waste matter or coal, in a fluidized-bed furnace and for burning the product gas produced by gasification to perform melt combustion in a melting furnace. The gasification and melt combustion apparatus is arranged to prevent clogging of the incombustible matter discharge opening. The present invention also relates to a method of operating the gasification and melt combustion apparatus.

BACKGROUND ART

Fig. 1 is a vertical sectional view of an example of

conventional gasification apparatus, schematically showing an essential part thereof. A fluidizing gas is supplied into a fluidized-bed furnace 1 through a fluidizing gas dispersing mechanism (fluidizing gas dispersing plate) 2 disposed in the furnace bottom. The fluidizing gas comprises a central fluidizing gas 3 supplied into the furnace from the central portion of the furnace bottom as an upward stream and a peripheral fluidizing gas 4 supplied into the furnace from the peripheral portion of the furnace bottom as an upward stream. The flow rate of the peripheral fluidizing gas 4 is set higher than the flow rate of the central fluidizing gas 3. The amount of air supplied into the gasification furnace is set smaller than the amount of air necessary for combustion of combustible matter 5 to form a reducing atmosphere in the fluidized-bed furnace 1.

The mass velocity of the central fluidizing gas 3 is set lower than the mass fluidizing velocity of the peripheral fluidizing gas 4. Consequently, a descending fluidized bed 7 in which a fluidized medium (generally, siliceous sand is used) settles and diffuses is formed in the central portion of the fluidized-bed furnace 1. In addition, an ascending fluidized bed 8 in which the fluidized medium is actively fluidized is formed in the peripheral portion of the fluidized-bed furnace 1. The fluidized medium moves upward in the ascending fluidized bed 8 at the furnace peripheral portion, as shown by the arrow A, and moves downward in the descending fluidized bed

7. Then, as shown by the arrow B, the fluidized medium moves along the fluidizing gas dispersing plate 2 and flows into the lower part of the ascending fluidized bed 8. Thus, a circulating flow of fluidized medium is formed, which circulates through the ascending fluidized bed 8 and the descending fluidized bed 7 in the direction shown by the arrows A and B.

Combustible matter 5 is supplied into the upper part of the descending fluidized bed 7 from a combustible matter supply opening 10. While moving downward through the descending fluidized bed 7, together with the fluidized medium, the combustible matter 5 is heated with the heat of the fluidized medium, and a volatile component in the combustible matter 5 is mainly gasified. Because the descending fluidized bed 7 contains a relatively small amount of oxygen, the product gas consisting essentially of the gasified volatile component does not burn, but passes through the descending fluidized bed 7 as shown by the arrow C. The product gas reaching a free board 11 moves upward as shown by the arrow D. Then, it is discharged as a product gas 12 from a gas outlet 13.

Matter that is not gasified in the descending fluidized bed 7, mainly char (fixed carbon) and tar, moves from the lower part of the descending fluidized bed 7 to the lower part of the ascending fluidized bed 8 in the furnace peripheral portion, together with the fluidized medium, as shown by the arrow B. The char, tar, etc. are burned and partially oxidized by the peripheral fluidizing

gas 4 containing a relatively large amount of oxygen. The ascending fluidized bed 8 forms an oxidizing zone for the combustible matter 5. In the ascending fluidized bed 8, the fluidized medium is heated to a high temperature by combustion in the ascending fluidized bed 8. The fluidized medium heated to a high temperature is turned over by a deflector 6 as shown by the arrow A. Thus, the fluidized medium shifts to the descending fluidized bed 7 and serves as a heat source for gasification again. An incombustible matter discharge passage 9 is disposed below the ascending fluidized bed 8. Incombustible matter in the combustible matter, waste matter, coals, etc., is discharged from the incombustible matter discharge passage 9, together with the fluidized medium.

In the gasification apparatus arranged as stated above, the fluidized medium includes a large amount of char differing from the conventional incinerator. Although the incombustible matter is discharged from the furnace together with the fluidized medium, when the excess air ratio at the hearth of the fluidized-bed furnace 1 is extremely low, char is produced on the hearth. If the char burns with the oxygen contained in the fluidizing gas to produce a local high-temperature region, the fluidized medium fuses to form clinker. In the incombustible matter discharge passage 9 or near the entrance thereof, combustible matter, e.g. char, contained in the fluidized medium as discharged, may burn with the oxygen contained in the fluidizing gas leaking from the ascending fluidized bed

8 and flowing into the incombustible matter discharge passage 9 and with the heat of the fluidized medium. The heat of combustion may fuse the fluidized medium (generally, siliceous sand) to form clinker. In the worst case, the incombustible matter discharge passage 9 may be clogged with the clinker.

SUMMARY OF THE INVENTION

The present invention was made in view of the above-described circumstances. An object of the present invention is to provide a gasification apparatus free from the formation of clinker in or near the incombustible matter discharge passage of the furnace, which would otherwise clog the incombustible matter discharge passage in the worst case, and also provide a method of operating the gasification apparatus. Another object of the present invention is to provide a gasification and melt combustion apparatus having a gasification furnace in which the incombustible matter discharge passage will not be clogged owing, for example, to the formation of clinker in or near the incombustible matter discharge passage of the furnace (or clogging of the incombustible matter discharge passage is suppressed), and also provide a method of operating the gasification and melt combustion apparatus.

To solve the above-described problem, the present invention provides a gasification apparatus for gasifying combustible matter by casting it into a fluidized bed, which is provided with an incombustible matter discharge passage. The gasification apparatus is characterized by

being provided with a fluidized medium stirring means for stirring a fluidized medium in or near the incombustible matter discharge passage.

The reason why clinker is formed in and near the incombustible matter discharge passage in the gasification apparatus having the above-described arrangement is as follows. The direction of movement of the fluidized medium flowing into the incombustible matter discharge opening when incombustible matter is discharged is reverse to the movement of the fluidized medium in the ascending fluidized bed. Therefore, the movement of the fluidized medium in this portion becomes locally stationary or locally slow. Thus, the movement of the fluidized medium becomes uneven. Consequently, combustible matter, e.g. char, together with heat (i.e. the heat of the heated fluidized medium) and oxygen (oxygen contained in the fluidizing gas leaking from the fluidized bed), is locally present in this portion. Therefore, a fluidized medium stirring means for stirring the fluidized medium in the above-described portion is provided as stated above to promote the stirring of the fluidized medium, thereby eliminating the above-described localized presence of combustible matter, e.g. char, together with heat and oxygen, and thus preventing the formation of clinker. Further, it is possible to discharge both the fluidized medium and incombustible matter.

The present invention provides a gasification apparatus for gasifying combustible matter by casting it into a fluidized bed, which is provided with an

incombustible matter discharge passage. The gasification apparatus is characterized by being provided with a means for supplying steam or an inert gas into or near the incombustible matter discharge passage.

The reason why clinker is formed in and near the incombustible matter discharge passage in the gasification apparatus having the above-described arrangement is that combustible matter, e.g. char, together with heat (i.e. the heat of the heated fluidized medium) and oxygen (oxygen contained in the fluidizing gas leaking from the fluidized bed), is present in this portion. Therefore, a means for supplying steam or an inert gas is provided as stated above, and steam or an inert gas is supplied into the incombustible matter discharge passage therefrom. Consequently, the fluidizing gas leaking from the fluidized bed is blocked from flowing into or near the incombustible matter discharge passage. Accordingly, the entry of oxygen contained in the fluidizing gas is also blocked. Thus, combustion of combustible matter, e.g. char, is prevented. As a result, heating of the fluidized medium by combustion is prevented, and hence the formation of clinker is prevented.

The present invention provides a method of operating a gasification apparatus for gasifying combustible matter by casting it into an upper part of a fluidized bed, which is provided with an incombustible matter discharge passage. The method is characterized by stirring a fluidized medium in or near the incombustible matter discharge passage at

least during the combustible matter gasifying operation to prevent the formation of clinker of the fluidized medium in or near the incombustible matter discharge passage of the gasification apparatus.

By stirring the fluidized medium in or near the incombustible matter discharge passage as stated above, the localized presence of combustible matter, e.g. char, together with heat and oxygen, in this portion is eliminated. Thus, it is possible to prevent the formation of clinker.

The present invention provides a method of operating a gasification apparatus for gasifying combustible matter by casting it into an upper part of a fluidized bed, which is provided with an incombustible matter discharge passage. The method is characterized by supplying steam or an inert gas into or near the incombustible matter discharge passage at least during the combustible matter gasifying operation to block the flow of a fluidizing gas leaking from the fluidized bed.

As has been stated above, steam or an inert gas is supplied into or near the incombustible matter discharge passage to block the flow of fluidizing gas leaking from the fluidized bed. Accordingly, the oxygen contained in the fluidizing gas is kept out to prevent combustion of combustible matter, e.g. char, flowing into the incombustible matter discharge opening. As a result, heating of the fluidized medium by combustion is prevented, and hence the formation of clinker is prevented.

The present invention provides a gasification apparatus provided with an incombustible matter discharge chute communicating with the incombustible matter discharge passage, wherein the incombustible matter discharge chute has a length not shorter than a length sufficient to block the flow of a fluidizing gas leaking from the fluidized bed by the seal action of a fluidized medium passing through the incombustible matter discharge chute.

Thus, the length of the incombustible matter discharge chute is set not shorter than a length sufficient to block the flow of fluidizing gas leaking from the fluidized bed by the seal action of the fluidized medium passing through the incombustible matter discharge chute. Therefore, the entry of oxygen contained in the leaking fluidizing gas is also blocked. Thus, combustion of combustible matter, e.g. char, is prevented. As a result, heating of the fluidized medium by combustion is prevented, and hence the formation of clinker is prevented.

In the gasification apparatus according to the present invention, the incombustible matter discharge chute is disposed to extend vertically to the lower part of the incombustible matter discharge passage.

The incombustible matter discharge chute is disposed to extend vertically to the lower part of the incombustible matter discharge passage as stated above. Therefore, the fluidized medium is uniformly filled into the incombustible matter discharge chute. Accordingly, the seal action of the fluidized medium is exhibited even more effectively.

Thus, leakage of the fluidizing gas can be satisfactorily blocked with a short incombustible matter discharge chute.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a vertical sectional view schematically showing an essential part of a conventional gasification apparatus.

Fig. 2 is a vertical sectional view schematically showing an essential part of a gasification apparatus according to the present invention.

Fig. 3 is a diagram for explaining the prevention of clinker formation at an incombustible matter discharge opening in the hearth of a gasification apparatus according to the present invention.

Fig. 4 is a vertical sectional view schematically showing an essential part of a gasification apparatus according to the present invention.

Fig. 5 is a diagram showing the arrangement of an essential part of a gasification apparatus to describe a gasification apparatus operating method according to the present invention.

Fig. 6 is a vertical sectional view schematically showing an incombustible matter discharge part of a gasification apparatus according to the present invention.

Fig. 7 is a diagram showing the way in which a fluidized medium is filled and also showing the way in which a fluidizing gas leaks when an incombustible matter discharge passage is disposed obliquely.

Fig. 8 is a vertical sectional view schematically

showing an incombustible matter discharge part of a gasification apparatus according to the present invention.

Fig. 9 is a vertical sectional view schematically showing an essential part of another gasification apparatus 30 according to the present invention.

Fig. 10 is a vertical sectional view schematically showing an essential part of another gasification apparatus 40 according to the present invention.

1: fluidized-bed furnace, 2: fluidizing gas dispersing mechanism (fluidizing gas dispersing plate), 3: central fluidizing gas, 4: peripheral fluidizing gas, 5: combustible matter, 6: deflector, 7: descending fluidized bed, 8: ascending fluidized bed, 9: incombustible matter discharge passage, 10: combustible matter supply opening, 11: free board, 12: product gas, 13: gas outlet, 14: gas or steam supply opening, 15: gas or steam, 16: oscillator, 17: vibrating part, 19: swing valve, 20: swing valve, 21: vibrating sieve, 22: incombustible matter chute, 23 fluidized medium chute, 24: thermometer, 25: water-cooled chute, 26: incombustible matter discharger, 75: vertical incombustible matter discharge chute, 76: incombustible matter discharge chute, 85: vertical incombustible matter discharge chute.

EMBODIMENTS OF THE INVENTION

Embodiments of the present invention will be described below with reference to the drawings. Fig. 2 is a vertical sectional view schematically showing an essential part of a gasification apparatus according to the

present invention. In Fig. 2, portions denoted the same reference symbols as those in Fig. 1 are the same or corresponding portions. The same shall apply in the other drawings. The gasification apparatus has an incombustible matter discharge passage 9 below an ascending fluidized bed 8. The gasification apparatus is provided with a gas supply opening 14 for supplying a gas or steam into or near the incombustible matter discharge passage 9 so that a gas can be supplied into or near the incombustible matter discharge passage 9 from the gas supply opening 14.

In the gasification apparatus arranged as stated above, a gas is supplied into or near the incombustible matter discharge passage 9 from the gas supply opening 14 during the operation of the apparatus, whereby a locally staying fluidized medium is stirred by both the motion of the fluidized medium discharged together with incombustible matter when the latter is discharged, and the ascending action of the fluidized medium in the ascending fluidized bed 8. Thus, it is possible to prevent the localized presence of combustible matter, e.g. char, or heat, oxygen, or a combustible gas, and hence possible to prevent the formation of clinker. The reason for this will be described later by using Fig. 3.

In the gasification apparatus arranged as stated above, steam is supplied into the incombustible matter discharge passage 9 from the gas supply opening 14 during the operation of the apparatus, thereby blocking the entry of oxygen contained in the ascending fluidized bed 8, which

would otherwise flow into the incombustible matter discharge passage 9 in the form of being caught in the fluidized medium discharged into an incombustible matter discharge means, together with incombustible matter. It is also possible to block the flow of fluidizing gas supplied from the fluidizing gas dispersing mechanism (dispersing plate) 2. Consequently, the amount of oxygen contained in the fluidizing gas is reduced, or no oxygen flows into the incombustible matter discharge passage 9. Therefore, combustion of combustible matter, e.g. char, is suppressed or prevented. Thus, heating of the fluidized medium by combustion is also prevented. It has been confirmed that the formation of clinker is prevented by the described scheme.

As shown in Fig. 2, a descending fluidized bed 7 in which a fluidized medium (generally, siliceous sand) heated to a high temperature settles and diffuses is formed in the central portion of the fluidized-bed furnace 1, and an ascending fluidized bed 8 in which the fluidized medium is actively fluidized is formed in the peripheral portion of the fluidized-bed furnace 1. In this state, combustible matter 5, i.e. municipal waste, biomass waste, shredder dust, waste tires, waste plastics, medical waste, industrial waste, or coal, or mixture containing at least one of these wastes is cast into the upper part of the descending fluidized bed 7 from a combustible matter supply opening 10 and gasified. In this operation, the fluidized medium frequently fuses in a diagonally shaded area E in

Fig. 3, i.e. in an area extending over from the inside of the incombustible matter discharge passage 9 to the entrance thereof, to form clinker. This tendency particularly strong when the combustible matter is waste plastics, waste tires, shredder dust, coal or the like, which is high in calories.

The reasons for the above are considered as follows. Firstly, the amount of char is large. Secondly, uneven movement of the fluidized medium, such as residence or stagnation, occurs at or near the boundary between the descending fluidized bed 7 and the ascending fluidized bed 8 in the incombustible matter discharge part, where the movement of the fluidized medium is slow. Consequently, a region where char and oxygen are abundant occurs. Accordingly, combustible matter, e.g. char, burns in this region with the heat of the fluidized medium and with oxygen contained in the fluidizing gas leaking from the ascending fluidized bed 8 and flowing into the incombustible matter discharge passage 9. The fluidized medium is heated by the heat of combustion. In addition, because the fluidized medium in the incombustible matter discharge passage 9 does not flow but simply descends slowly (i.e. descends slowly while maintaining the fluidized state), the heat of the heated fluidized medium is not sufficiently diffused. As a result, a region where the temperature becomes locally high occurs. In such a region, the fluidized medium or other incombustible matter fuses to form clinker.

Therefore, a gas supply opening 14 is provided in the incombustible matter discharge passage 9, preferably in the opening of the incombustible matter discharge passage 9 near the fluidizing gas dispersing plate 2, and a gas or steam 15 is supplied into the incombustible matter discharge passage 9 from the gas supply opening 14, thereby stirring the fluidized medium staying in the vicinity of the incombustible matter discharge passage 9, and thus preventing the localized presence of oxygen and combustible matter, e.g. char, in the fluidized medium. Consequently, there is no heating of the fluidized medium by local combustion of combustible matter, and hence no clinker is formed. On the other hand, the fluidizing gas is prevented from flowing into the incombustible matter discharge passage 9 from the ascending fluidized bed 8 or the fluidizing gas dispersing plate 2. Consequently, the amount of oxygen contained in the above-described local region is reduced, or no oxygen is present in the local region. Thus, combustion of combustible matter, e.g. char, is prevented. Accordingly, there is no heating of the fluidized medium by the combustion of combustible matter, and hence no clinker is formed.

In the foregoing embodiment, a gas or steam is supplied into the incombustible matter discharge passage 9, by way of example. More specifically, air, or a gas containing a reduced amount of oxygen (O_2), or steam may be supplied. It is also possible to use an inert gas, e.g. nitrogen (N_2) gas, or combustion exhaust gas. Further, when

combustible matter, char, heat, or the like is also locally, unevenly distributed in the descending fluidized bed 7, the above-mentioned inert gas may be used as the fluidizing gas supplied to the descending fluidized bed 7 among the fluidizing gas supplied through the fluidizing gas dispersing plate 2 to enhance the fluidization of the descending fluidized bed 7, thereby stirring the fluidized medium in the descending fluidized bed 7 to eliminate the foregoing localized presence.

Fig. 4 is a vertical sectional view schematically showing an essential part of another gasification apparatus according to the present invention. This gasification apparatus has an incombustible matter discharge passage 9 below an ascending fluidized bed 8. A stirring machine comprising an oscillator 16 and a vibrating part 17 is provided in the incombustible matter discharge passage 9 or between the incombustible matter discharge passage 9 and the fluidized bed so that it is possible to stir the fluidized medium moving from the fluidized bed into the incombustible matter discharge passage 9.

In the gasification apparatus arranged as stated above, the vibrating part 17 is vibrated in the incombustible matter discharge passage 9 or near the entrance thereof by the oscillator 16 during the operation of the apparatus, thereby stirring the fluidized medium discharged into the incombustible matter discharge passage 9, together with incombustible matter. Thus, the fluidized medium can be prevented from staying there. Consequently,

it is possible to prevent combustible matter, e.g. char, or heat or oxygen from being locally present in the incombustible matter discharge passage 9 or near the entrance thereof, and hence possible to prevent the formation of clinker. The stirring machine is not necessarily limited to the foregoing one. Any existing stirring machine can be used.

Next, an example of the method of operating the gasification apparatus arranged as stated above will be described by using Fig. 5. In Fig. 25, a water-cooled chute 25 is connected to the incombustible matter discharge passage 9 in the fluidized-bed furnace 1 of the gasification apparatus. Incombustible matter containing a fluidized medium, which is discharged from the incombustible matter discharge passage 9, is cooled in the water-cooled chute 25. The incombustible matter drops into an incombustible matter discharger 26. The incombustible matter is sent from the incombustible matter discharger 26 to a vibrating sieve 21 through swing valves 19 and 20 intermittently in fixed quantities. The incombustible matter is separated into the fluidized medium and incombustible matter by the vibrating sieve 21. The incombustible matter is discharged to the outside of the system through an incombustible matter chute 22. The fluidized medium is sent to an elevator (not shown) through a fluidized medium chute 23 and then supplied into the fluidized-bed furnace 1 again to circulate.

First, to start the operation in a cold state where

the fluidized medium has not yet been heated, i.e. in the case of cold start, a fluidizing gas is supplied from the bottom of the hearth. While it is being fluidized, the fluidized medium is heated by a burner (not shown) until the fluidized bed temperature reaches a predetermined temperature. When the fluidized bed temperature has reached the predetermined temperature, the incombustible matter discharger 26 and so forth are operated to begin the circulation of the fluidized medium. When the hearth temperature further rises to a predetermined temperature, casting of combustible matter 5, e.g. municipal refuse, into the fluidized bed is begun, and the fluidized medium temperature is checked (measured) with a thermometer 24 provided on the water-cooled chute 25.

When the fluidized medium temperature measured with the thermometer 24 has reached a predetermined temperature (e.g. 400°C), stirring in the incombustible matter discharge passage 9, or the supply of a gas or steam, is begun.

To start the operation in a state where the fluidized medium is at a high temperature, i.e. in the case of hot start, the circulation of the fluidized medium is begun immediately after the fluidization of the fluidized medium has been begun by supplying a fluidizing gas from the bottom of the hearth. After it has been confirmed that the temperature of the water-cooled chute 25 measured with the thermometer 24 is not lower than a predetermined temperature, stirring of the fluidized medium near the

incombustible matter discharge passage 9 is performed as described in connection with Fig. 2 or 4. Alternatively, it is possible that steam or an inert gas is supplied into the incombustible matter discharge passage 9 from the gas or steam supply opening 14 as described in connection with Figs. 2 and 3. Then, casting of combustible matter 5 into the gasification apparatus is begun.

When fluidization of the fluidized medium is being performed with the casting of the combustible matter 5 stopped, the stirring of the fluidized medium near the incombustible matter discharge passage 9, or the supply of steam or the like, is continued while the operation of the fluidized medium circulating system is continued. When the fluidization of the fluidized medium is to be suspended by stopping the supply of the fluidizing gas, the foregoing stirring or the supply of steam is stopped a predetermined time (e.g. 5 minutes) after the fluidization has been suspended.

Although the foregoing embodiment uses a fluidized-bed gasification apparatus having a descending fluidized bed in the central portion and an ascending fluidized bed in the peripheral portion, it will be apparent that the advantageous effects of the present invention can be exhibited regardless of the form of the fluidized bed, provided that the fluidized-bed gasification apparatus used has an incombustible matter discharge passage in the fluidized bed.

When the fluidized medium is to be removed with the

casting of the combustible matter 5 stopped, the supply of steam or the like is continued until the fluidized medium has completely come out of the furnace. When the temperature rises during the operation, the amount of inert gas supplied is increased so that the temperature of the thermometer 24 will not exceed a predetermined temperature.

In the foregoing embodiment, steam or an inert gas, e.g. N_2, is supplied into the incombustible matter discharge passage 9 to block the flow of fluidizing gas leaking from the ascending fluidized bed 8 and flowing into the incombustible matter discharge passage 9. It should be noted, however, that where steam or an inert gas is supplied is not necessarily limited to the inside of the incombustible matter discharge passage 9 but may be an area near the incombustible matter discharge passage 9 (e.g. the entrance thereof), provided that the flow of fluidizing gas can be blocked to prevent it from leaking to the incombustible matter discharge passage 9.

Further, in the foregoing embodiment, the present invention is applied to a fluidized-bed gasification apparatus having a descending fluidized bed 7 in the central portion and an ascending fluidized bed 8 in the peripheral portion. However, it will be apparent that the advantageous effects of the present invention can be exhibited regardless of the type of fluidized bed, provided that the fluidized-bed gasification apparatus used has an incombustible matter discharge passage.

As has been stated above, a fluidized medium

(siliceous sand) is filled into the incombustible matter discharge passage 9, and the fluidized medium gradually moves downward to the incombustible matter discharger. the fluidized medium filled in the incombustible matter discharge passage 9 has the action of blocking the flow of fluidizing gas leaking from the descending fluidized bed 7 and the ascending fluidized bed 8, i.e. material seal action. Fig. 6 is a diagram showing an example of the arrangement of a gasification apparatus designed to prevent the leakage of fluidizing gas by the material seal action of the fluidized medium in the incombustible matter discharge passage 9, thereby preventing the formation of clinker in or near the incombustible matter discharge passage 9.

As shown in Fig. 6, a vertical incombustible matter discharge chute 75 with a predetermined length L is provided between the incombustible matter discharger 26 and the junction of the incombustible matter discharge passage 9 communicating with the lower part of the ascending fluidized bed 8 in the fluidized-bed furnace 1 to block the flow of fluidizing gas leaking from the descending fluidized bed 7 and the ascending fluidized bed 8 in the fluidized-bed furnace 1 by the seal action (material seal action) of the fluidized medium filled in the vertical incombustible matter discharge chute 75.

In a case where the incombustible matter discharge chute 76 connected to the incombustible matter discharge passage 9 below the ascending fluidized bed 8 is sloped as

shown in Fig. 7, the density of the fluidized medium in the incombustible matter discharge chute 76 varies such that the fluidized medium is "sparse" in the upper part 76a and "dense" in the lower part 76b. Accordingly, the leak Q1 of fluidizing gas passing through the upper part 76a, where the fluidized medium is "sparse", is larger than the leak Q2 of fluidizing gas passing through the lower part 76b (Q1>Q2). Therefore, the seal action cannot sufficiently be exhibited. In contrast, if the vertical incombustible matter discharge chute 75 is provided to extend vertically to the lower end of the junction of the incombustible matter discharge passage 9 as stated above, the density of the fluidized medium in the vertical incombustible matter discharge chute 75 becomes uniform. Thus, a uniform seal action can be obtained.

The leak Q/A of fluidizing gas per unit area when the vertical incombustible matter discharge chute 75 is provided is expressed by

$$Q/A=f(\rho, \varepsilon, \mu, L)$$

where Q: the leak of fluidizing gas; A: the horizontal sectional area of the vertical incombustible matter discharge chute 75; ρ: the density; ε: the voids; μ: the viscosity of the fluidizing gas; and L: the length of the vertical incombustible matter discharge chute 75.

Accordingly, if the length L of the vertical incombustible matter discharge chute 75 is set longer than a predetermined length, the leak of fluidizing gas (i.e. the amount of oxygen contained in the leaking fluidizing

gas) becomes less than the amount of oxygen necessary for combustion of combustible matter, e.g. char, contained in the fluidized medium. Thus, the combustion of such combustible matter can be prevented.

In the foregoing embodiment, a vertical incombustible matter discharge chute 75 with a predetermined length L is additionally provided between the junction of the incombustible matter discharge passage 9 and the incombustible matter discharger 26. However, the arrangement may be as shown in Fig. 8. That is, the incombustible matter discharge passage 9 communicating with the lower part of the ascending fluidized bed 8 in the fluidized-bed furnace 1 is extended vertically to provide a vertical incombustible matter discharge chute 85, and the lower end of the vertical incombustible matter discharge chute 85 is communicated with the incombustible matter discharger 26. In this case, the lower part of the fluidized-bed furnace 1 can be constructed in a compact form because the incombustible matter discharge passage 9 needs no sloped chute to join with the vertical incombustible matter discharge chute.

Fig. 9 is a vertical sectional view schematically showing an essential part of another gasification apparatus 30 according to the present invention. In Fig. 9, portions denoted the same reference symbols as those in Figs 1-5 are the same or corresponding portions. The gasification apparatus 30 comprises a starter burner 31 at an upper part of a fluidized bed furnace 1, a pair of

barrier plate 32, 33, secondary air supply port 34 for supply a secondary air S. The apparatus 30 comprises an incombustible matter discharge passage 9 below an ascending fluidized bed 8. The passage 9 has a gas opening 14 through which an inert gas is supplied into the passage 9 so as not to generate a clinker. Instead of the inert gas, a water vapor can be used. Further, instead of supply of the inert gas in to the passage 9, the passage 9 can be provided with a vibrating part 17 in order to prevent generation of a clinker therein, similarly to the vibrating part 17 in order to prevent generation of a clinker therein, similarly to the vibrating part 17 in the apparatus shown in Fig. 4.

Fig. 10 is a vertical sectional view schematically showing an essential part of another gasification apparatus 40 according to the present invention. In Fig. 10, portions denoted the same reference symbols as those in Figs 1-5 are the same or corresponding portions. The gasification apparatus 40 comprises a fluidized bed furnace 1 having a fluidized gas dispersing plate 2 and a fluidized bed 58 above the plate 2. N_2 gas is supplied to the fluidized bed 58. Produced gas 12 is introduced through a passage 13 into a cottrell 45 and separated into a gas discharged through a passage 46 and particles such as char discharged through a passage 47. The fluidized bed furnace 1 has an incombustible matter discharge passage 9 below the fluidized bed 58. The passage 9 has a gas opening 14 through which an inert gas

is supplied into the passage 9 so as not to generate a clinker. Instead of the inert gas, a water vapor (steam) can be used. Further, instead of supply of the inert gas in to the passage 9, the passage 9 can be provided with a vibrating part 17 in order to prevent generation of a clinker therein, similarly to the vibrating part 17 in the apparatus shown in Fig. 4. The incombustible matter is sent through the passage 9 into a magnetic separator 42 and separated to metal components discharged through a passage 43 and residual matter. The residual matter is pulverized by a crusher 44 and supplied through a passage 48 into a melting furnace (not shown) together with particles discharged though the passage 47.

Figs. 2 and 3 show a circulating flow formed by ascending and descending fluidized beds, however, it is sufficient for carrying out the present invention that a gasification (heat-dissolution) is performed by forming a circulating flow fluidized medium regardless of direction of the flow. For instance, in the fluidized-bed furnace in Fig. 2, the incombustible matter discharge passage 9 can be changed to be at the center portion of the fluidized bed furnace 1 and the directions of the arrows A and B in Fig. 2 can be changed to have opposite directions. The present invention is applicable to the above mentioned cases to prevent formation of clinker in the incombustible matter discharge passage.

EFFECTS OF THE INVENTION

As has been stated above, the present invention

provides the following advantageous effects. In the present invention, the fluidized medium is stirred in or near the incombustible matter discharge passage to eliminate the localized presence of char or oxygen, which would otherwise cause local heating in the fluidized bed, and to promote the diffusion of heat. Therefore, the formation of clinker is prevented, and there is no likelihood that the incombustible matter discharge passage may be clogged. Thus, the passing performance of the incombustible matter discharge passage in the gasification furnace can be maintained favorably. Accordingly, a gasification and melt combustion apparatus having the gasification furnace according to the present invention can favorably maintain the operation of the gasification furnace. Hence, the application of the present invention allows the operation of the whole gasification and melt combustion apparatus to be maintained even more favorably.

According to the present invention, steam or an inert gas is supplied into or near the incombustible matter discharge passage to block the flow of fluidizing gas leaking from the fluidized bed and flowing into the incombustible matter discharge opening. Accordingly, the amount of oxygen is reduced, or no oxygen is present in the incombustible matter discharge passage. This prevents the combustion of combustible matter, e.g. char, flowing into the incombustible matter discharge passage. As a result, the formation of clinker due to heating of the fluidized medium is prevented, and there is no likelihood that the

incombustible matter discharge passage may be clogged. Thus, the passing performance of the incombustible matter discharge passage in the gasification furnace can be maintained favorably. Accordingly, a gasification and melt combustion apparatus having the gasification furnace according to the present invention can favorably maintain the operation of the gasification furnace. Hence, the application of the present invention allows the operation of the whole gasification and melt combustion apparatus to be maintained even more favorably.

According to the present invention, the length of the incombustible matter discharge chute is set not shorter than a length sufficient to block the flow of fluidizing gas leaking from the fluidized bed by the seal action of the fluidized medium passing through the incombustible matter discharge chute. Therefore, the entry of oxygen contained in the leaking fluidizing gas is also blocked. Thus, combustion of combustible matter, e.g. char, is prevented. As a result, heating of the fluidized medium by combustion is prevented, and hence the formation of clinker is prevented. Therefore, the passing performance of the incombustible matter discharge passage in the gasification furnace can be maintained favorably. Accordingly, a gasification and melt combustion apparatus having the gasification furnace according to the present invention can favorably maintain the operation of the gasification furnace. Hence, the application of the present invention allows the operation of the whole gasification and melt

combustion apparatus to be maintained even more favorably.

According to the present invention, the incombustible matter discharge chute is disposed to extend vertically to the lower part of the incombustible matter discharge passage. Therefore, the fluidized medium is uniformly filled into the incombustible matter discharge chute disposed vertically. Accordingly, the seal action of the fluidized medium is exhibited even more effectively. Thus, leakage of the fluidizing gas can be satisfactorily blocked with a short incombustible matter discharge chute.

In the foregoing fluidized-bed furnace, a circulating flow is formed by an ascending fluidized bed and a descending fluidized bed. It should be noted, however, that the fluidized-bed furnace in the present invention is only required to attain slow gasification (pyrolysis) by a circulating flow of fluidized medium formed therein. Therefore, the position of the incombustible matter discharge passage and the direction of the circulating flow are not necessarily limited to those in the foregoing embodiments, as a matter of course. That is, regarding the position of the incombustible matter discharge passage, the incombustible matter discharge passage 9 in the embodiment shown in Fig. 2 may be located in the center of the furnace, i.e. the central discharge type. The incombustible matter discharge passage may also be of the one-side discharge type in which only a half of the incombustible matter discharge passage shown in Fig. 2 (i.e. either of the left and right halves divided by a line of mirror symmetry) is

installed. The direction of the circulating flow should preferably be considered in relation to the discharge position (i.e. the capability of discharging incombustible matter). However, the direction of the circulating flow may be selected as desired, e.g. counterclockwise turning or clockwise turning. In such a case, it is also possible to use the technical idea of the present invention for ensuring the incombustible matter discharging capability required for the incombustible matter discharge passage as in the case of the foregoing embodiments, as a matter of course.

CLAIMS

1. A gasification apparatus for gasifying combustible matter by casting it into a fluidized bed, said gasification apparatus being provided with an incombustible matter discharge passage,

which is characterized by being provided with fluidized medium stirring means for stirring a fluidized medium in or near said incombustible matter discharge passage.

2. A gasification apparatus for gasifying combustible matter by casting it into a fluidized bed, said gasification apparatus being provided with an incombustible matter discharge passage,

which is characterized by being provided with means for supplying steam or an inert gas into or near said incombustible matter discharge passage.

3. A gasification apparatus for gasifying combustible matter by casting it into a fluidized bed, said gasification apparatus being provided with an incombustible matter discharge passage,

which is characterized by being provided with an incombustible matter discharge chute communicating with said incombustible matter discharge passage, said incombustible matter discharge chute having a length not shorter than a length sufficient to block a flow of a fluidizing gas leaking from said fluidized bed by a seal action of a fluidized medium passing through said incombustible matter discharge chute.

4. A gasification apparatus according to claim 3, wherein said incombustible matter discharge chute is disposed to extend vertically to a lower part of said incombustible matter discharge passage.

5. A method of operating a gasification apparatus for gasifying combustible matter by casting it into an upper part of a fluidized bed, said gasification apparatus being provided with an incombustible matter discharge passage,

said method being characterized by stirring a fluidized medium in or near said incombustible matter discharge passage at least during an operation of gasifying said combustible matter to prevent formation of clinker of the fluidized medium in or near the incombustible matter discharge passage of said gasification apparatus.

6. A method of operating a gasification apparatus for gasifying combustible matter by casting the matter into an upper part of a fluidized bed, said gasification apparatus being provided with an incombustible matter discharge passage,

said method being characterized by supplying steam or an inert gas into or near said incombustible matter discharge passage at least during an operation of gasifying said combustible matter.

Fig. 1

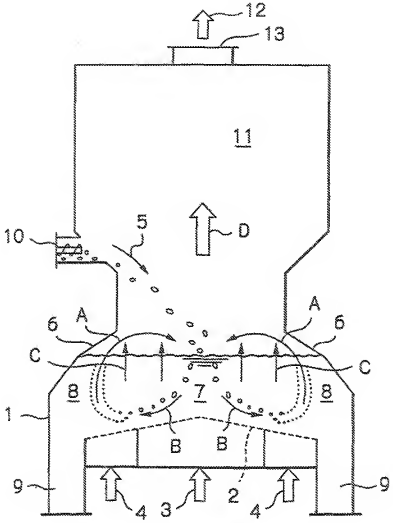

Fig. 2

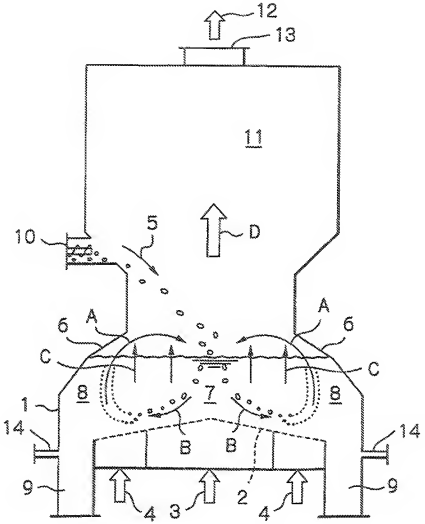

Fig. 3

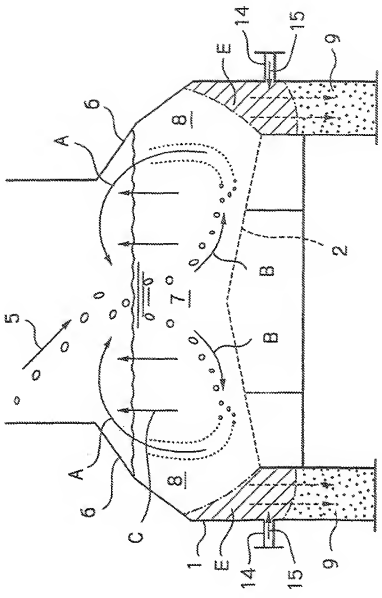

Fig. 4

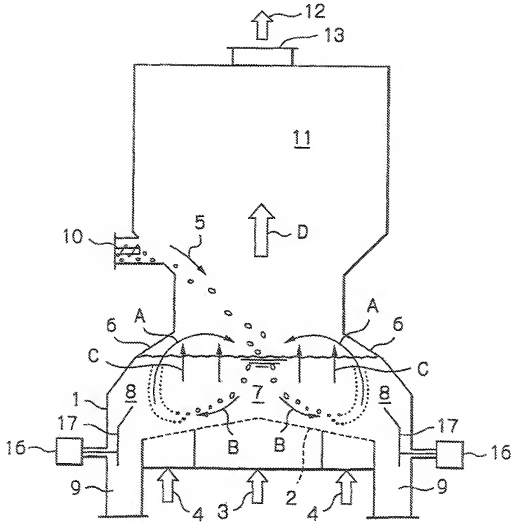

Fig. 5

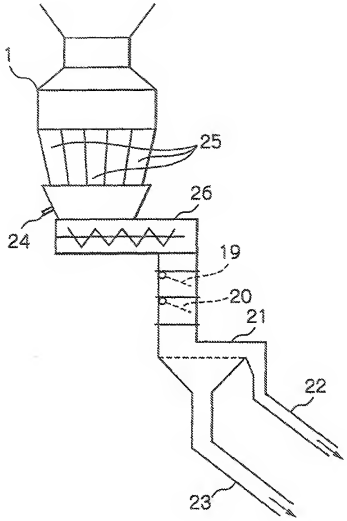

Fig. 6

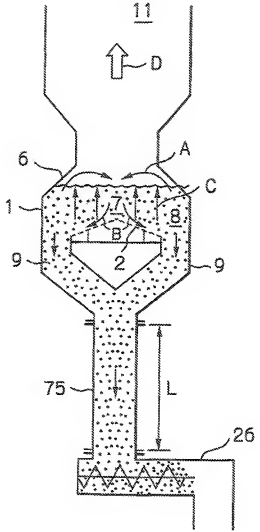

Fig. 7

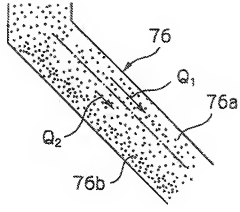

Fig. 8

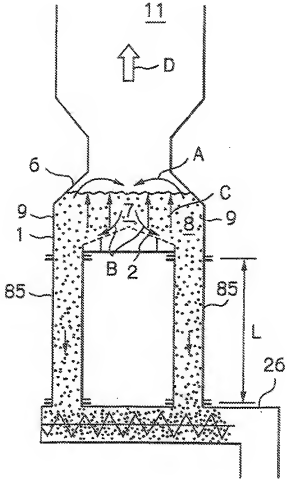

Fig. 9

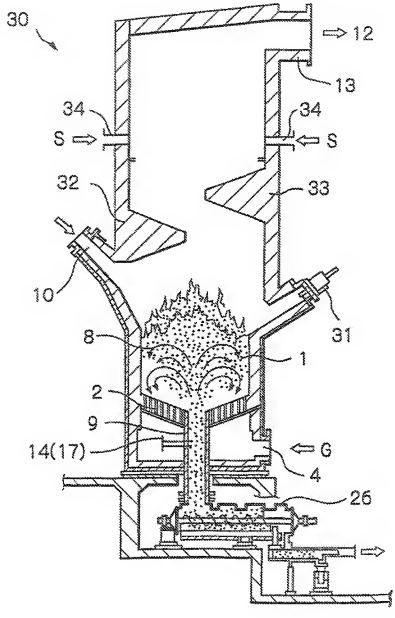

Fig. 10